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NASA CR-132733
October 1975

FLIGHT SERVICE EVALUATION
OF KEVLAR-49/EPOXY COMPOSITE
PANELS IN WIDE-BODIED COMMERCIAL
TRANSPORT AIRCRAFT

SECOND ANNUAL
FLIGHT SERVICE EVALUATION REPORT
BY
R. H. STONE

PREPARED UNDER CONTRACT NAS1-11621
FOR
LANGLEY RESEARCH CENTER
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
HAMPTON, VIRGINIA

LOCKHEED-CALIFORNIA COMPANY
BURBANK, CALIFORNIA

A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

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FOREWORD

This is the second annual flight service evaluation report on the condition of Kevlar-49 (formerly termed PRD-49) fairing panels installed on three L-1011's under NASA Contract NAS 1-11621 "Flight Service Evaluation of Kevlar-49 Composite Panels in Wide-Bodied Commercial Transport Aircraft". The manufacture and installation of these panels was completed in February 1973 and reported in NASA CR-112250 dated March 1973 (Ref. 1). The results of inspections after the first year of flight service were reported in Ref. 2. Annual reports will be issued describing service performance after three, four, and five years of service.

This program is being administered by the Langley Research Center, National Aeronautics and Space Administration with Mr. Benson Dexter of the Materials Division as the Project Engineer.

This program is being performed by Lockheed-California with Robert H. Stone the Program Leader, with assistance provided by T. L. Crawford, D. H. Horadem, R. S. Beck, and J. Luney of the Product Support Branch; and J. Wooley of the Materials and Producibility Department.

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ABSTRACT

Kevlar-49 fairing panels were inspected and found to be performing satisfactorily after two years flight service on an Eastern and an Air Canada L-1011. Six panels are on each aircraft including sandwich and solid laminate wing-body panels, and 300°F service aft engine fairings. The inspections were conducted at the airline maintenance bases, with the participation of Lockheed Engineering. Some of the panels were removed from the aircraft to permit inspection of inner surfaces and fastener hole conditions.

Minor defects such as surface cracks due to impact damage, small delaminated areas, elongation and fraying of fastener holes, were noted. None of these defects were considered serious enough to warrant corrective action in the opinion of airline personnel. The defects are typical for the most part of defects noted on similar fiberglass parts.

A set of Kevlar-49 fairing panel, which had been removed from the TWA aircraft on which they were initially installed, were reinstalled on a second TWA L-1011. This involved considerable rework to relocate fastener holes. This rework was successfully accomplished using standard fiberglass procedures. Care was required in the case of 300°F service repair materials to prevent part damage.

1.0 INTRODUCTION AND BACKGROUND

The subject program on flight service evaluation of Kevlar-49 fairings consists of fabrication, installation and flight service of eighteen nonstructural panels; six on each of three L-1011's. The three participating airlines are Eastern, TWA, and Air Canada. Fabrication and installation of the panels was completed in February 1973, with initiation of flight service occurring in early 1973 on all three aircraft.

The six fairings are all similar to baseline fiberglass designs in which Kevlar-49 fabric, (comparable in fabric weave and thickness per ply to the fiberglass), was substituted for the fiberglass on a ply for ply basis. This required no other design changes or development of new tooling for layup and cure, but still provided a potential weight savings of 25-30%. These six parts are as follows:

- 1) A left-hand and right-hand set of a large (60 inch x 67 inch) sandwich wing-body fairing panel. The exterior skin is .020" thick with 1 ply 181 style Kevlar-49 fabric and 2 plies 120 style Kevlar-49 fabric. The interior skin is .015" thick with three plies of 120 style Kevlar-49 fabric. The honeycomb core is Nomex with 1/8 inch cells, and 3.0 lbs/cu.ft. density.
- 2) A left-hand and right-hand set of a small (9 inch x 33 inch approximately) solid laminate wing-body fillet panel. The laminate incorporates 9 plies of 181 style Kevlar-49 fabric ply and is approximately .09 inches thick.
- 3) A left-hand and right-hand set of an aft engine sandwich fairing (30 inch x 72 inch approximately). The skins are .020 inch thick with 1 ply 181 style Kevlar-49 fabric and 2 plies 120 style Kevlar-49 fabric. The Nomex core is identical to that used in the wing-body fairing.

The Kevlar-49 panels all utilized the same resin system as the production fiberglass parts: A 250°F curing, 180°F service epoxy for the wing-body fairing and fillet panels, and a 350°F curing, 300°F service epoxy for the aft engine fairings. All of the parts have an outer layer of flame sprayed aluminum and topcoat applied according to standard production procedures used on the baseline fiberglass parts. The actual weight savings achieved by this direct substitution of Kevlar-49 for fiberglass averaged 26% for the six parts. Further details on Kevlar-49 part design and fabrication are given in NASA CR-112250, (Ref. 1).

Under the original program plan, inspections of the Kevlar-49 parts were to take place annually in conjunction with regularly scheduled inspections at the airline maintenance bases. However, the first annual inspections of the TWA and Air Canada panels took place at Lockheed-California Co. due to special circumstances, while the Eastern panels were inspected by Eastern personnel at Miami. Results of those inspections indicated no significant damage or deterioration of the parts other than minor impact damage, fastener hole elongation, and minor delaminations. Comparable damage was also noted on similar fiberglass parts. Further details are given in reference 2.

In order to obtain thorough information and documentation of part conditions, the inspection activity was expanded as follows for the second annual inspections of the Eastern and Air Canada panels:

- 1) A Lockheed Engineering representative was present for the inspections at Miami and Montreal.
- 2) Three of the six panels (one of each left-hand and right-hand set) were removed for thorough inspection, and to permit inspection of fastener holes and interior surface conditions.
- 3) The part condition was documented in summary form using special formats provided to the airlines.

The TWA panels were removed after approximately one year (2400 hours) of service when the aircraft was taken of service in April 1974, because of a cabin interior fire. The parts were not damaged and were returned to Lockheed for inspection. The parts were subsequently installed on a second TWA L-1011 for continuation of flight service testing. The reinstallation on TWA aircraft N31030 required some rework and repair of the panels, particularly in the case of the aft engine fairing panels, where relocation of all fastener holes was required. This rework activity is reported in detail herein. The aircraft on which these parts were reinstalled was delivered to TWA in August 1975.

2.0 INSPECTION OF EASTERN AND AIR CANADA PANELS

The Kevlar-49 fairings in flight service on Eastern Air Lines Aircraft N314EA were inspected at Miami in April 1975 by Eastern and Lockheed personnel. The panels at that time had been in flight service approximately two years with 6061 flight hours and 3001 flights. Three of the six parts were removed for inspection. These were the left-hand members of each of the three part categories described previously. The parts were visually examined on both surfaces for contaminants and defects such as cracks, dents, elongated holes, fraying of fibers around holes and cut edges, voids, and delaminations. The surfaces were also coin tapped to detect the presence and extent of any delaminated, unbonded, or void areas. In addition, the exterior surfaces of the right-hand wing-body fairing and wing-body fillet panels were visually examined and coin tapped in the same manner. These parts were accessible because of their location, and were the most prone to impact damage because of their proximity to galley and cargo loading areas. The right-hand aft engine fairing was not examined closely, because of lack of access at the time of inspection. Photographs were taken of the parts and of all areas showing defects or damage.

No serious defects or damaged areas were noted, and none of the observed defects warranted corrective action in the opinion of Eastern Maintenance personnel. The observations are summarized in detail in Appendix I.

The Kevlar-49 fairings in flight service on Air Canada Aircraft CF-TNB-502 were inspected at Montreal in May 1975. The panels at that time had been in service for two years with 4324 flight hours and 2559 flights. The fairing

panels were visually inspected and coin tapped in the same manner as described above for the Eastern panels. The four wing-body panels were initially inspected on the aircraft by Lockheed and Air Canada personnel. Two weeks later, at a subsequent inspection, the right-hand wing-body fillet panel was removed for inspection of interior surface and fastener hole conditions. Also, the aft engine fairings were inspected in place on the aircraft at this time. Photographs were taken of all parts and areas showing defects or damage.

The Air Canada panels, like the Eastern panels, showed only minor defects or damage, none of which were considered serious or which warranted corrective action in the option of Air Canada Maintenance Engineering. The observations are summarized in detail in Appendix II.

3.0 REINSTALLATION OF TWA PANELS

The six TWA panels were reinstalled on TWA Aircraft N31030 in February 1975. Only minor rework was required for reinstallation of the four wing-body panels involving repair of one crack, refinishing, and relocation (filling and redrilling) of six fastener holes. The two aft engine fairings required considerably more rework, as relocation of all fastener holes was required. A problem was encountered with the 300°F service filler material. This material had to be cured at 335°F, and after the initial cure a skin-core delamination, and debonding of the Tedlar moisture barrier film on the inner surface were noted. These were repaired, and the final cure operations were conducted with the part under vacuum and with heat-up rates carefully controlled. This eliminated any further delamination problems. The rework procedures required for reinstallation of the Kevlar-49 panels are described in detail in Appendix III.

4.0 SUMMARY OF RESULTS AND CONCLUSIONS

After two years (up to 6000 hours) of flight service, no major defects or damage requiring corrective action was noted on the Kevlar-49 parts. The following conditions were noted:

- 1) Surface cracks, particularly in sandwich skin areas, due to impact damage.
- 2) Delaminated areas, usually noted in conjunction with areas of crushed core.
- 3) Elongation of fastener holes, particularly on the wing-body fillet panels.
- 4) Fraying of fibers at fastener holes.
- 5) Presence of contaminants consisting of grime and oily residue but with no indication of phosphate ester hydraulic fluid.
- 6) Chipping and blistering of paint which does not appear related to the substitution of Kevlar-49 for fiberglass.

These are all conditions typically noted on fiberglass panels with the exception of the frayed fibers. Comparable damage to fastener holes in fiberglass parts would not result in this frayed appearance, because of the brittle characteristics of the glass fibers. It should be noted that adjacent fiberglass parts were not removed and inspected, so that comparisons of the Kevlar-49 parts with fiberglass parts is based on known fiberglass service history and viewing the fiberglass parts on the aircraft with all fasteners installed.

These inspection results indicate that for periods up to 6000 flight hours, Kevlar-49 laminates and sandwich panels perform satisfactorily and provide serviceability and environmental resistance at least equivalent to fiberglass parts.

The successful rework and reinstallation of the TWA panels indicates that standard fiberglass rework procedures can be used with Kevlar-49 parts, and continuing flight service of these panels will provide confirmation. Special precautions are needed for rework of Kevlar-49 or fiberglass parts requiring 300°F service materials.

REFERENCES

1. Wooley, J. H., Paschal, D. R., and Crilly, E. R.; "Flight Service Evaluation of PRD-49/Epoxy Composite Panels in Wide-Bodied Commercial Transport Aircraft - Final Report"; NASA CR-112250, March 1973.
2. Wooley, J. H.; "Flight Service Evaluation of PRD-49/Epoxy Composite Panels in Wide-Bodied Commercial Transport Aircraft - First Annual Flight Service Report"; NASA CR-132647, July 1974.

APPENDIX I - DETAIL OBSERVATIONS
OF KEVLAR-49 FAIRING PANELS

EASTERN AIR LINES AIRCRAFT N314EA
APRIL 1975

LEFT-HAND WING-BODY FAIRING P/N 1515599-109

This panel was removed from the aircraft for detailed inspection. The lower half of the panel exterior was covered with a layer of dirt and grime and streaks of black, gummy deposits as shown in Figure 1. The gummy deposit appears to be rubber which blows back onto the exterior fairing surface. These deposits are typical of all lower exterior fairing surfaces. Paint chipping was noted around many fasteners and particularly along the aft edge of the panel as shown in Figure 2. Also, gap sealant adhering to the panel on the upper aft corner caused the paint to peel when the sealant and panel were moved. The flame sprayed aluminum was intact over the entire panel.

A repair patch 1-1/4 x 1-3/4 inches was noted near the center of the panel as shown in Figure 3. The repair was performed with aluminum speed tape which was coated with a conductive metal filled epoxy. An area around the patch approximately 4 x 3 inches was also coated, possibly to cover an area in which paint had been removed. The cause of the damage could not be determined.

The fastener holes along the upper, forward, and aft edges had slight fraying but no noticeable hole elongation. The laminate along the lower panel edge was deformed around the holes. This deformation was convex and showed on the inner face only. However, the holes along this edge showed somewhat more fraying than those along the other edges.

The inner face of the panel had an oily film on the upper edge and heavy oily patches on the aft edge as shown in Figure 4. The nature of the oil is not certain. It did not have the characteristic pungent odor of hydraulic oil, but the panels have potential exposure to phosphate ester fluid because of hydraulic lines located above the panels.

A 1/2 inch diameter void was noted near the top forward edge of the panel on the inner surface. A delaminated strip approximately 6 inches long and 1/2 inch wide extended from this void. However, the Tedlar moisture barrier appeared to be intact throughout.

LEFT-HAND WING-BODY FILLET, P/N 1545328-109

Upon removal of this fillet, considerable grime and black deposits were noted on the inner surface as shown in Figure 5. There was an oily residue on the inner surface; apparently it was not phosphate ester fluid since no

pungent odor was noticed. A gouged spot was noted on the upper forward corner, and paint and flame sprayed aluminum were missing in several locations on the exterior surface. Several elongated and frayed holes were observed as shown in Figures 6 and 7.

LEFT-HAND AFT ENGINE FAIRING, P/N 1538592-129

The inner surface of this panel, particularly the aft end, contained a considerable amount of oil, as shown in Figure 8. The oily residue did not appear to be hydraulic fluid. The outer surface of the panel was extremely dirty with a streaked appearance as shown in Figure 9. Several holes along the laminate edge were frayed with approximately 1/4 inch diameter delaminations around the holes (Figures 10 and 11). It should be noted that the fraying and delaminations are observable only from the inside of the panel. There was no evidence of additional defects in the panel.

RIGHT-HAND WING-BODY FAIRING, P/N 1515599-110

The right-hand panels were not removed, therefore, a visual inspection of the outer surface only was conducted. Two cracks 5/16 inch long and 1/8 inch long were noted in the outer skin as shown in Figure 12. The origin of these cracks is not known. The general appearance of the entire outer surface is similar to that of the left-hand wing-body fairing.

RIGHT-HAND WING-BODY FILLET, P/N 1545328-110

The external appearance of this fillet is similar to that of the left-hand fillet with only minor paint chipping around the fasteners. No evidence of any defects were noted.

RIGHT-HAND AFT ENGINE FAIRING, P/N 1544685-117

Because of the location of this panel no close observations were made. However, the outer surface appearance of this panel is similar to that of the left-hand panel.

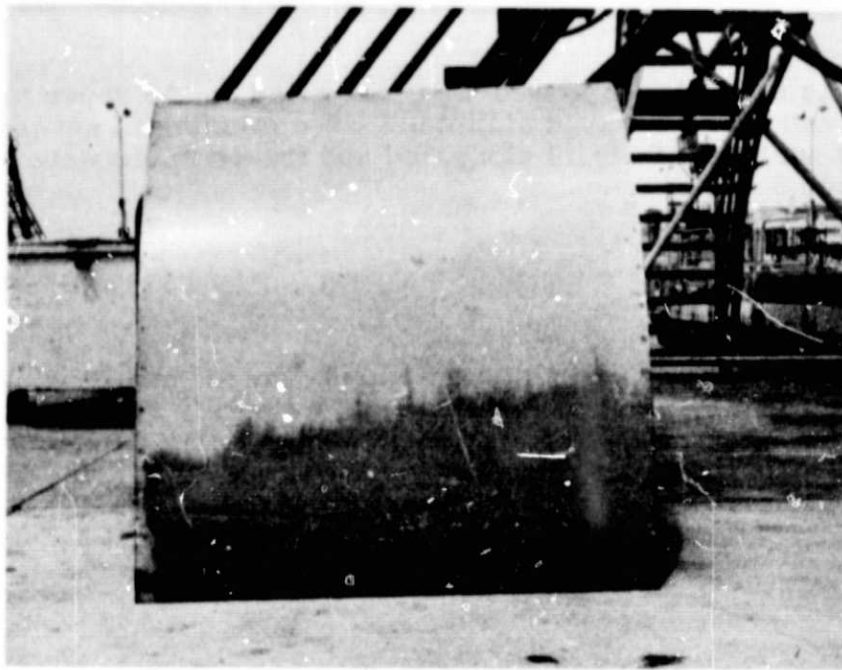


Figure 1. - Eastern LH Wing-Body Fairing -
Exterior surface

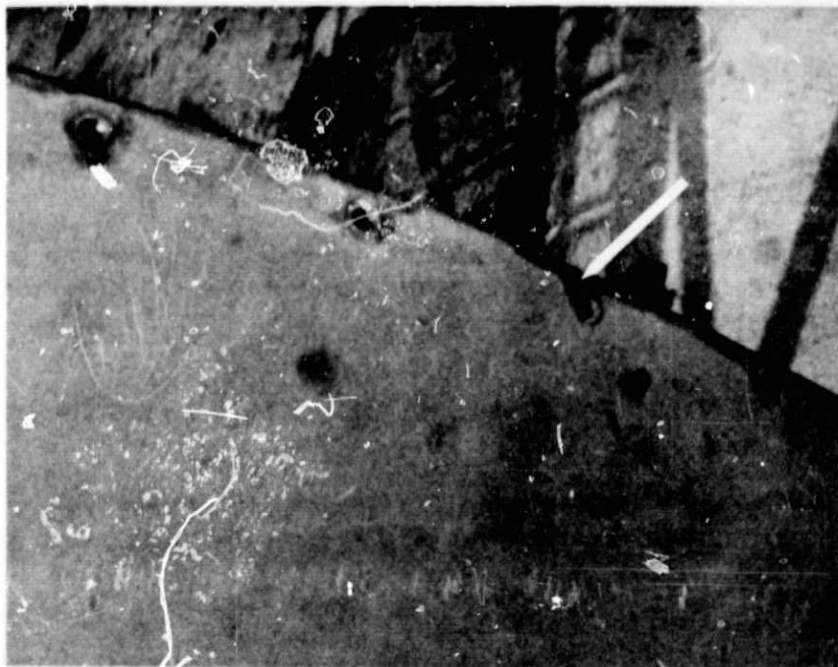


Figure 2. - Eastern LH Wing-Body Fairing -
with chipped paint

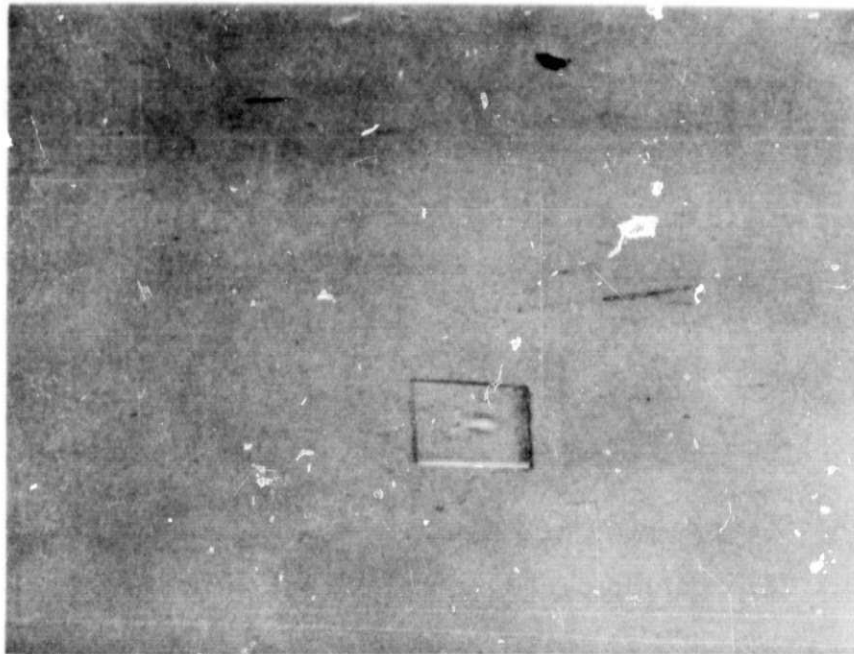


Figure 3. - Eastern LH Wing-Body Fairing -
Repair patch

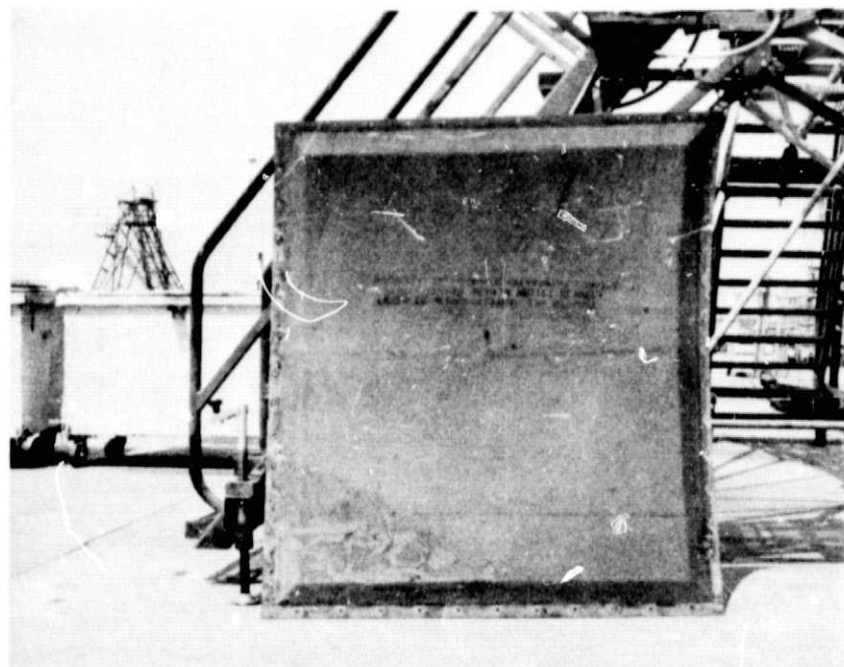


Figure 4. - Eastern LH Wing-Body Fairing -
Inner surface

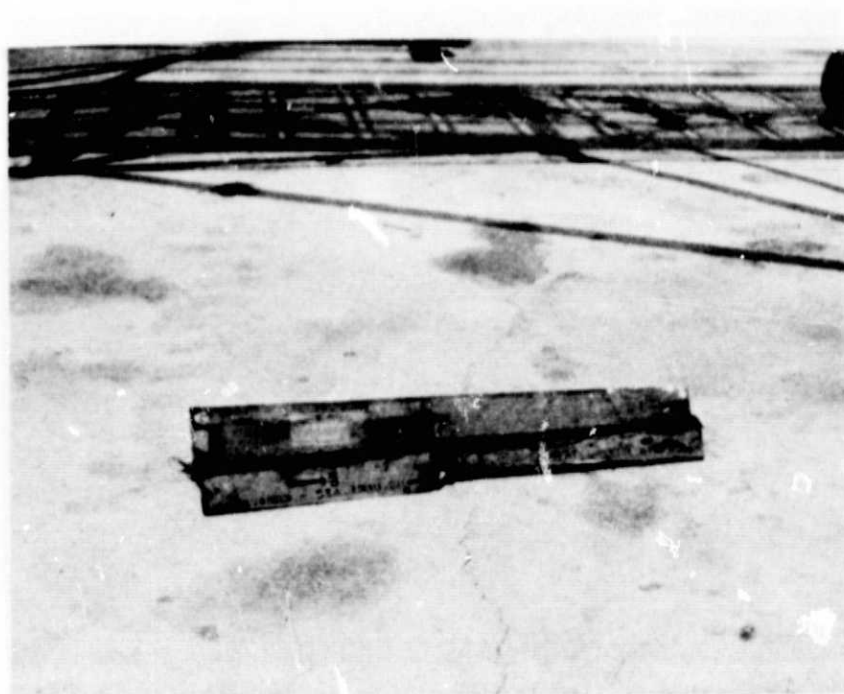


Figure 5. - Eastern LH Wing-Body Fillet -
Inner surface

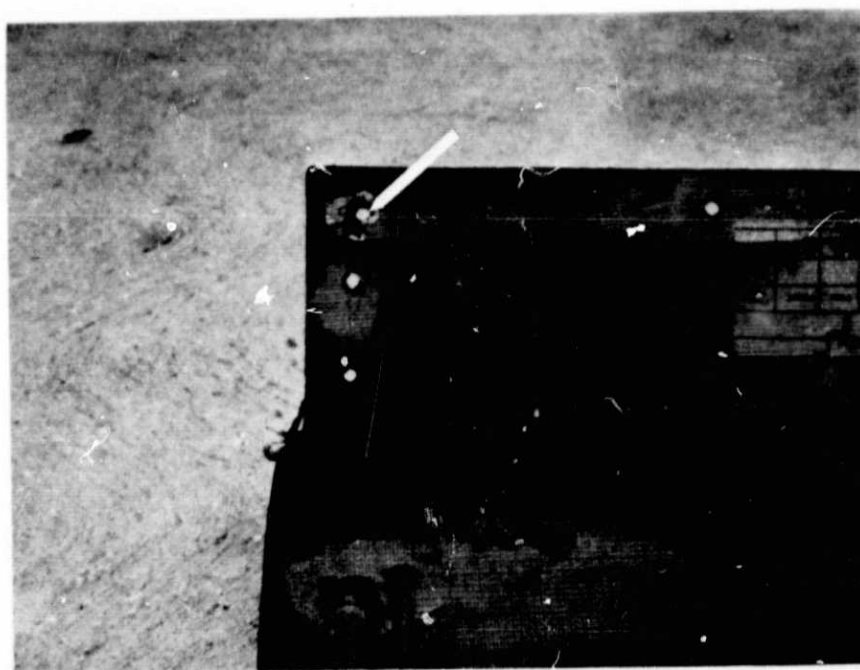


Figure 6. - Eastern LH Wing-Body Fillet -
Elongated holes

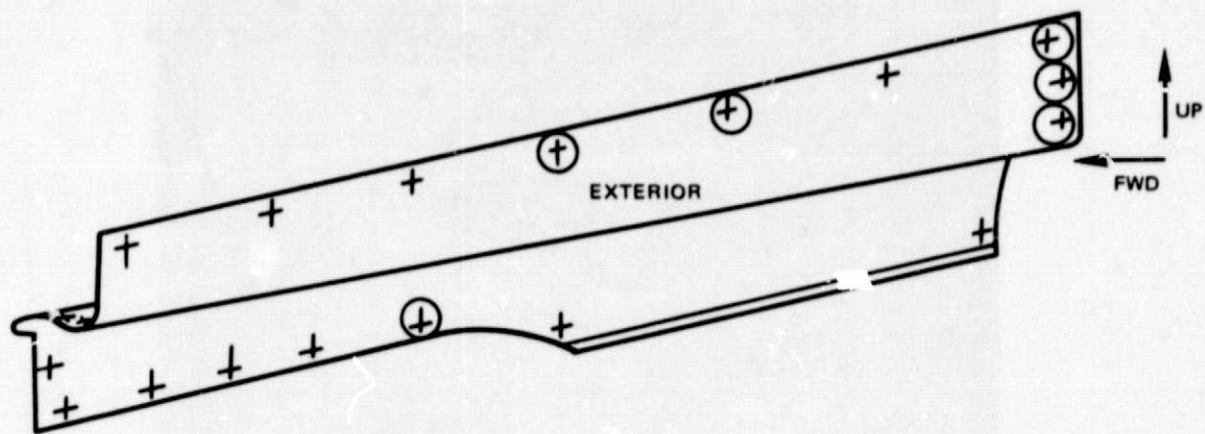


Figure 7. - Eastern LH Wing-Body Fillet -
Location of elongated holes

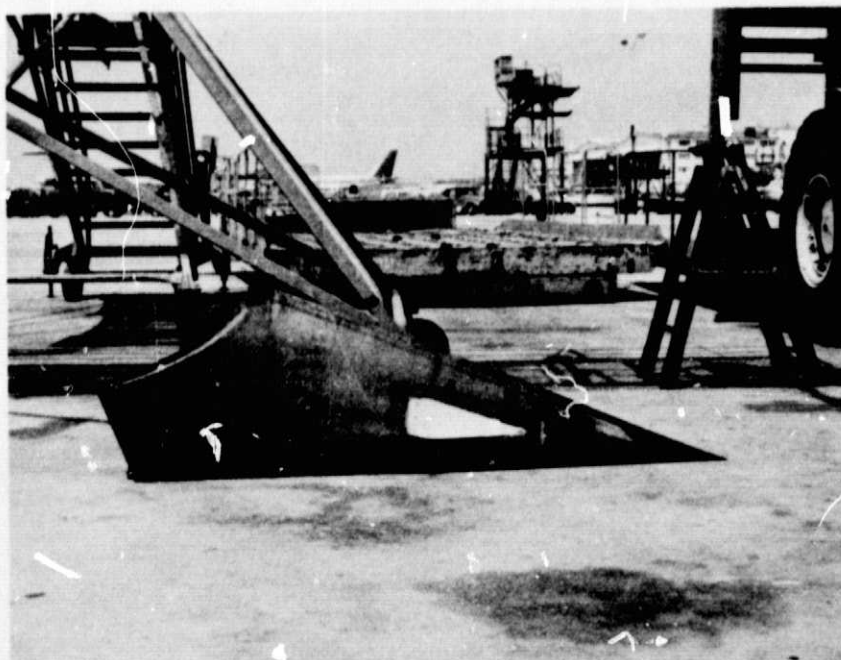


Figure 8. - Eastern LH Aft Engine Fairing -
Inner surface

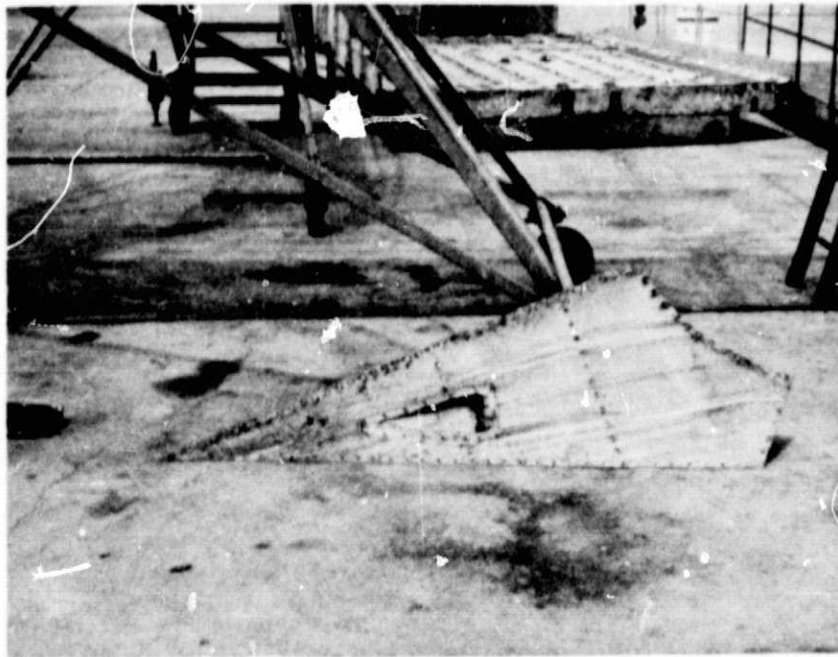


Figure 9. - Eastern LH Aft Engine Fairing -
Exterior surface

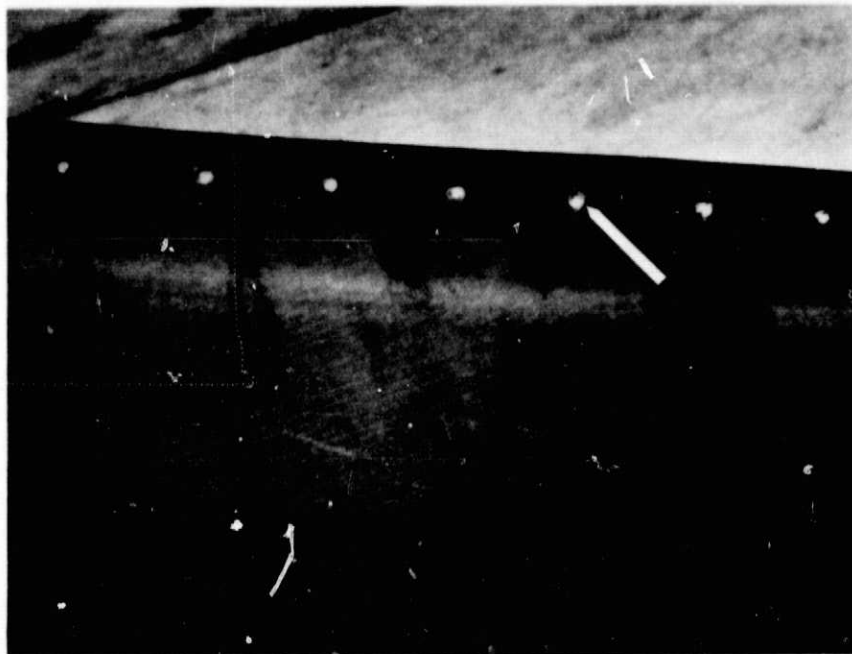


Figure 10. - Eastern LH Aft Engine Fairing -
Frayed fastener holes

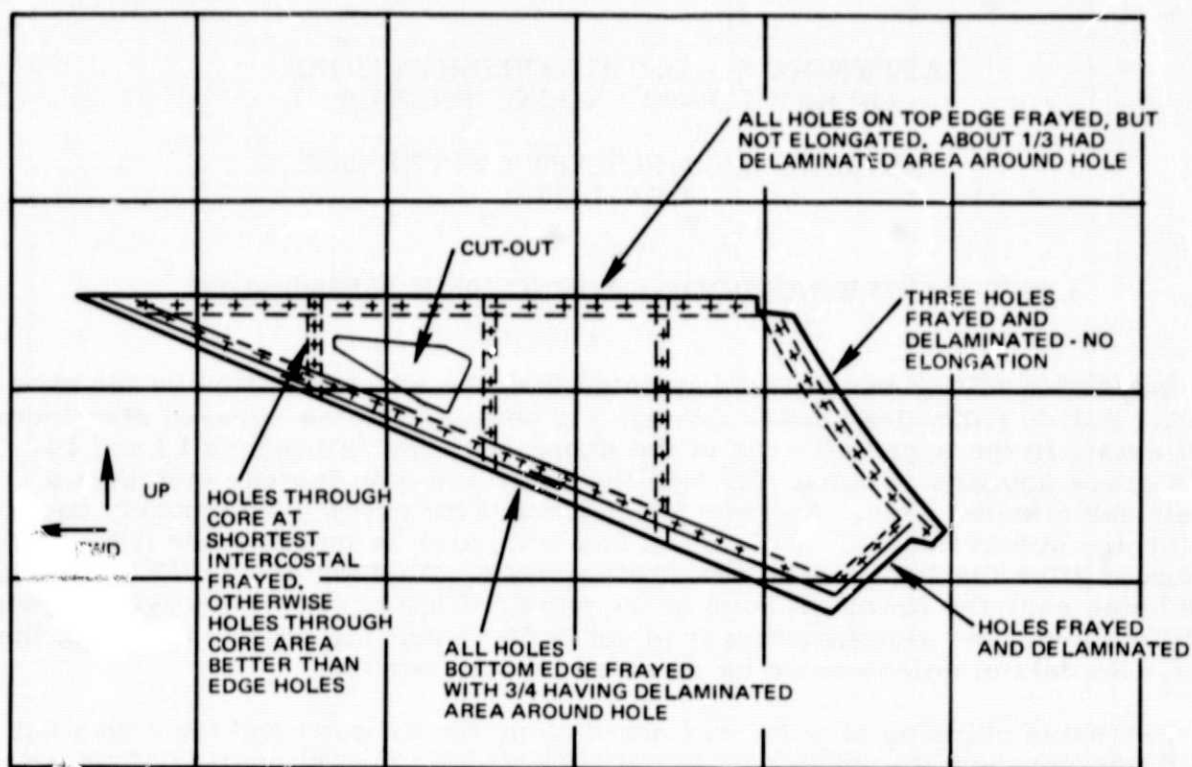


Figure 11. - Eastern LH Aft Engine Fairing - Location of fastener hole defects

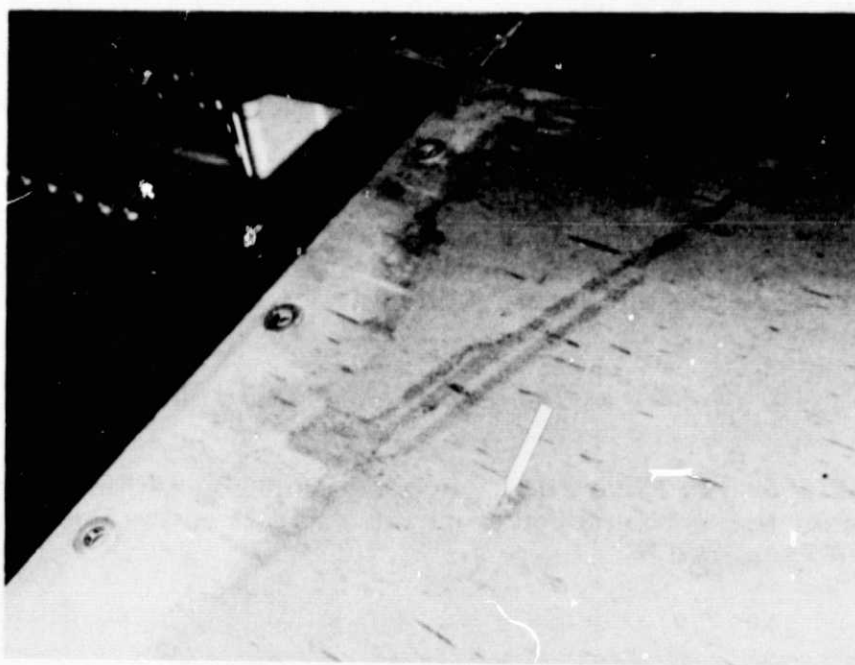


Figure 12. - Eastern RH Wing-Body Fairing - showing crack on exterior skin

APPENDIX II - DETAIL OBSERVATIONS
OF KEVLAR-49 FAIRING PANELS

AIR CANADA AIRCRAFT CF-TNB-502
MAY 1975

LEFT-HAND WING-BODY FAIRING, P/N 1515599-109

Inspection of this panel was conducted with the panel installed on the aircraft. A 1-1/4 inch long crack through the paint and flame sprayed aluminum still exists in the upper aft area of the panel as shown in Figures 13 and 14. This crack appears to extend through the skin, and coin tapping indicates a small delaminated area. An indentation around the crack was probably caused by foreign object impact. This crack has not grown in length since it was first reported after the 1974 inspection, Reference 2. Another crack 1/2 inch long was noted near the lower aft edge of the panel. This crack is through the paint and flame sprayed aluminum but it is not definite that the crack is through the skin. No delaminations could be detected by coin tapping.

Extensive chipping of paint was noted along the forward and top edges but the flame sprayed aluminum was intact. There was a light coating of grime over the exterior surface and black streaks probably caused by rubber particles were noted primarily near the bottom of the panel as shown in Figure 14. A thin oily film which did not appear to be hydraulic fluid was noted around fasteners and the panel edges. Also, minor damage areas were noted in the aft upper and lower corners. (Figure 14)

LEFT-HAND WING-BODY FILLET, P/N 1545328-109

The exterior surface of this fillet was inspected without removal from the aircraft. Considerable grime and a slightly oily residue were noted on the surface. Paint chipping around fasteners was noted, and gaps were observed between fastener heads and the panel; particularly in the aft area.

LEFT-HAND AFT ENGINE FAIRING, P/N 1538592-129

This panel as shown in Figure 15 is in good condition with no evidence of defects. The panel was not removed from the aircraft so the inner surface condition was not examined.

RIGHT-HAND WING-BODY FAIRING, P/N 1515599-110

This panel was inspected without removal from the aircraft. A 1/4 inch long crack was noted near the forward top edge of the panel. The crack is through the paint and flame sprayed aluminum but it is not definite that the crack extended through to the honeycomb core. Grime and streaks of rubber similar to that on the left-hand panels were observed.

RIGHT-HAND WING-BODY FILLET, P/N 1545328-110

This panel was removed from the aircraft for detailed inspection. Considerable grime and an oily residue were noted on the external surface as shown in Figure 16. Paint chipping around fasteners and on the upper surface was noted.

Bent or out of line fasteners with gaps between fastener heads and panel were noted as indicated in Figure 17. Also, the lower aft edge of the panel appeared to be bulged outward slightly. Indications are that this panel was forced to fit the aircraft fastener hole pattern. Elongation of fastener holes along the aft end of the panel was noted as shown on the interior view of Figure 18.

RIGHT-HAND AFT ENGINE FAIRING, P/N 1544685-117

This panel was not removed from the aircraft for inspection. Considerable blistering of paint and a corroded appearance was noted. There was some evidence of pitting on the external surface as shown in Figures 19 and 20. The pitting and the corroded appearance are likely related to damage of the flame sprayed aluminum. Paint blistering was also noted on this part at the first annual inspection, Reference 2. The loose paint was removed from the fairing after the first inspection and it was repainted prior to reinstallation. The paint adhesion problem, possibly related to inadequate removal of mold release after part fabrication, has thus reoccurred within one years time. In view of the absence of this problem on the left-hand Kevlar fairing, the paint adhesion does not appear related to the substitution of Kevlar-49 for fiberglass.

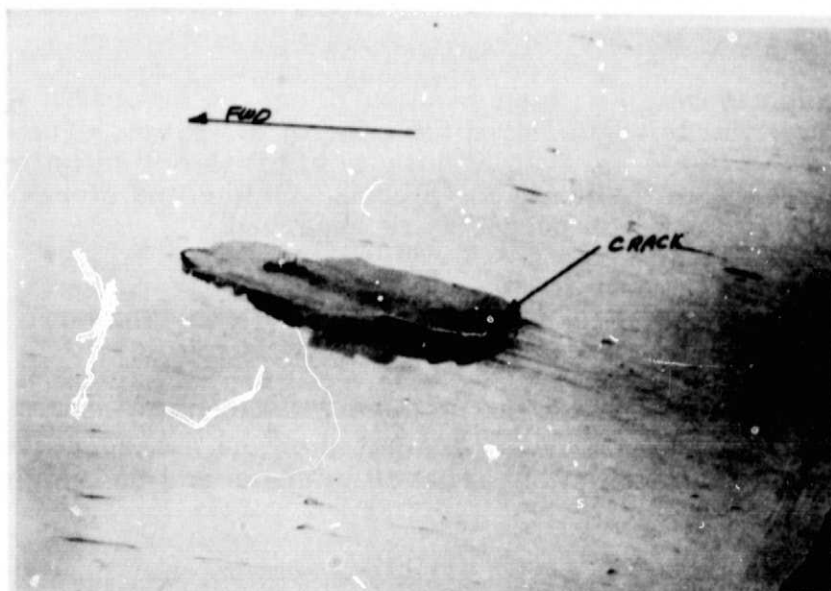


Figure 13. - Air Canada LH Wing-Body Fairing -
Exterior surface crack

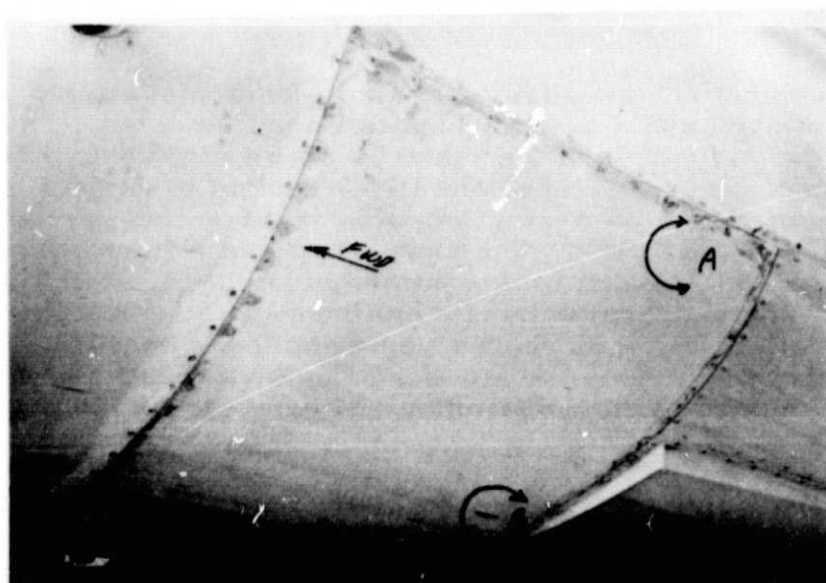


Figure 14. - Air Canada LH Wing-Body Fairing -
Exterior

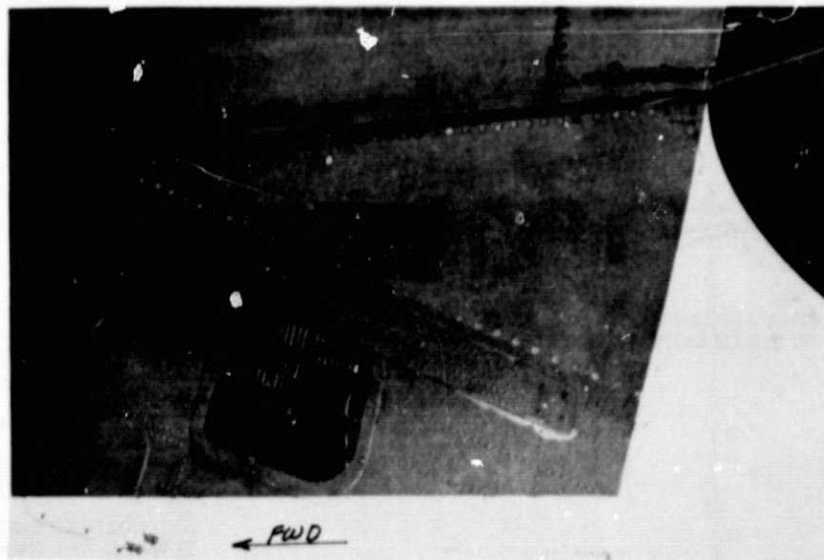


Figure 15. - Air Canada LH Aft Engine Fairing -
Exterior

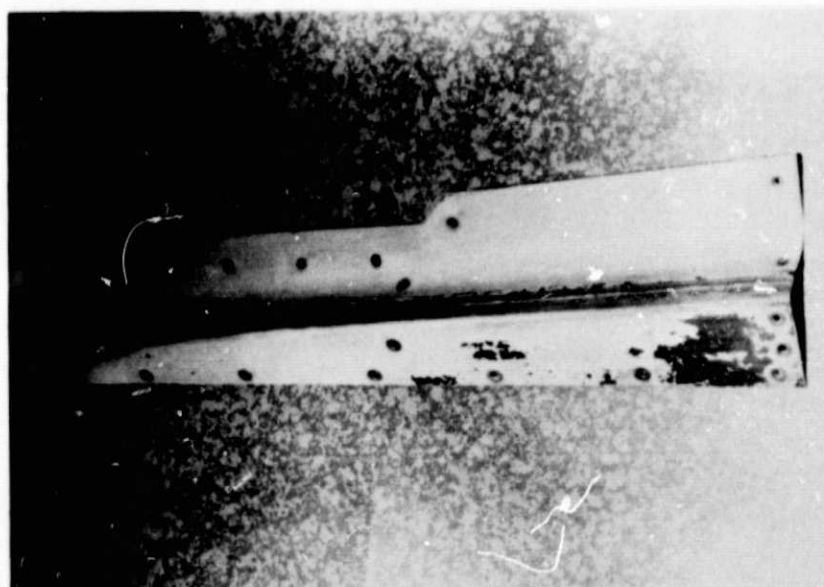


Figure 16. - Air Canada RH Wing-Body Fillet -
Exterior

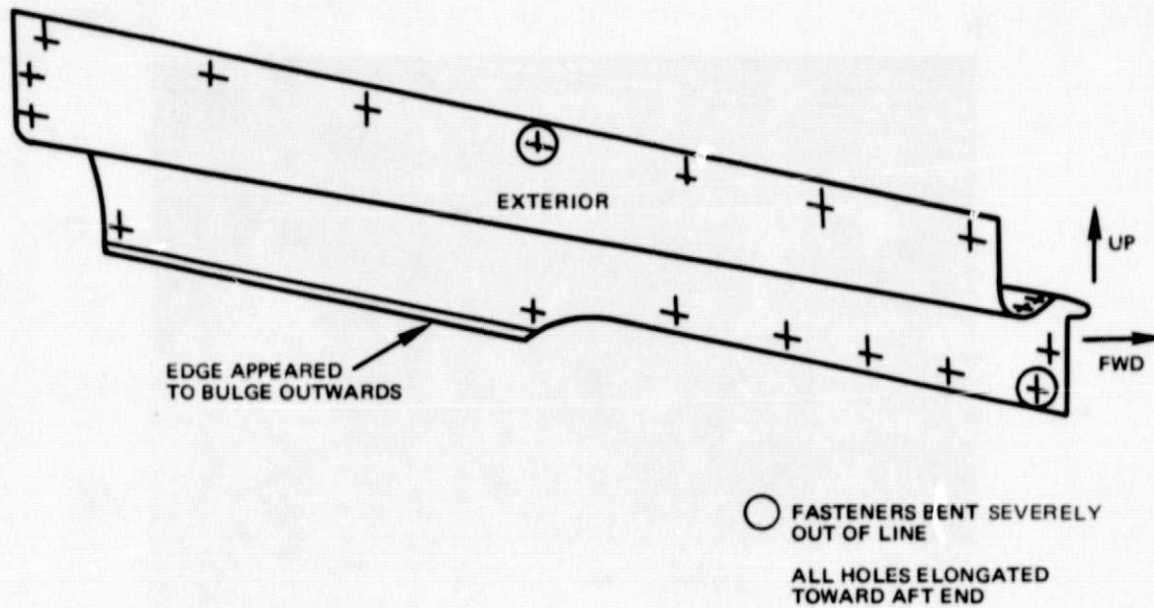


Figure 17. - Air Canada RH Wing-Body Fillet -
Location of defect areas

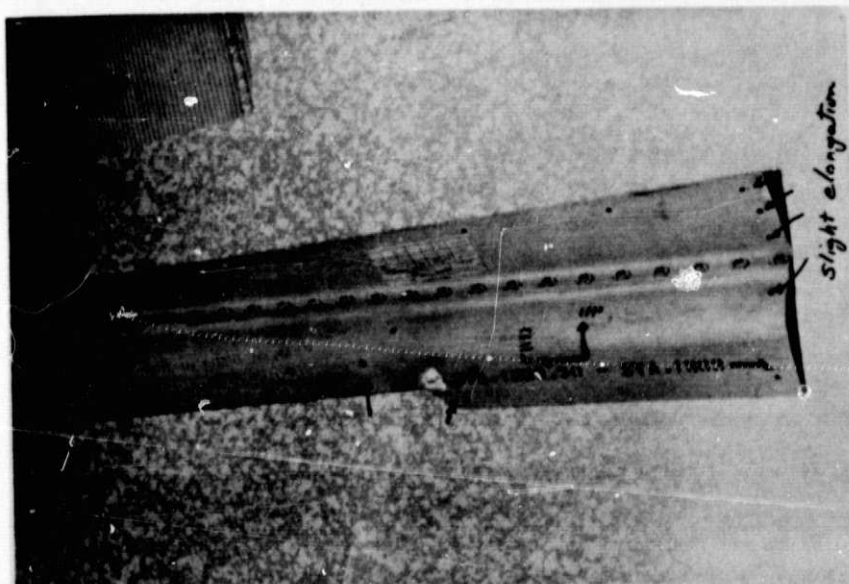


Figure 18. - Air Canada RH Wing-Body Fillet -
Inner surface

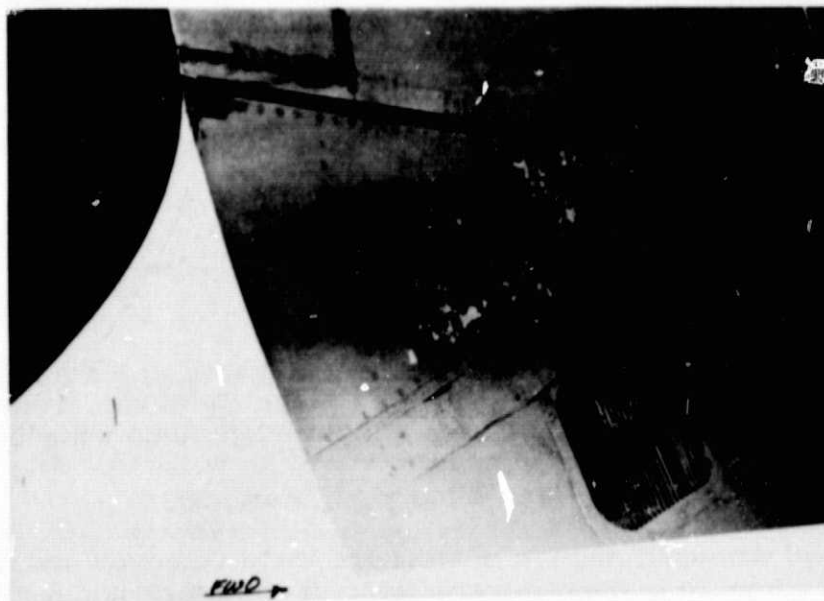


Figure 19. - Air Canada RH Aft Engine Fairing - Exterior

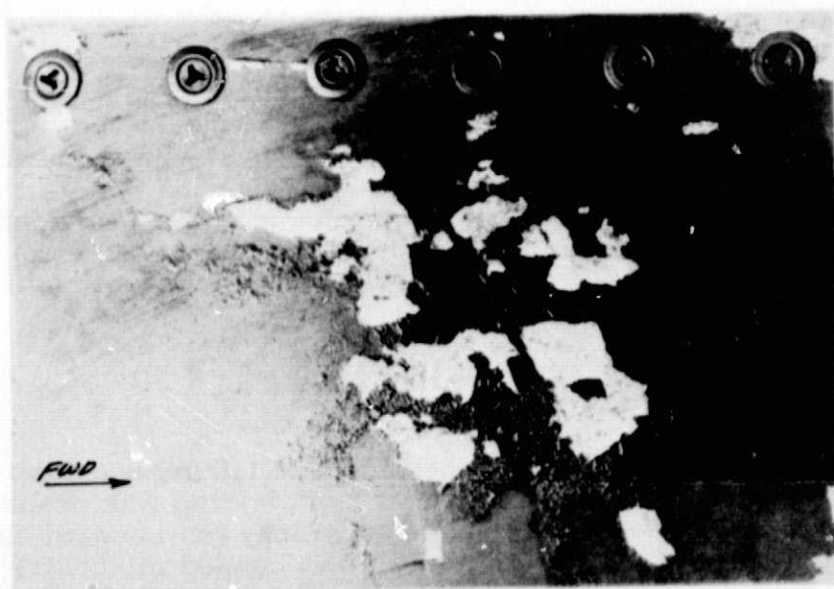


Figure 20. - Air Canada RH Aft Engine Fairing - Blistered paint

APPENDIX III

KEVLAR-49 FAIRING REWORK FOR INSTALLATION ON TWA AIRCRAFT N31030

WING-BODY FAIRINGS AND WING-BODY FILLETS

The only visible damage to any of these four parts was a small crack in the exterior skin of the right hand wing-body fairing. However, relocation of holes was required for both wing-body fillets and the right hand wing-body fairing.

(1) Repair of Crack in Right Hand Wing-Body Fairing:

The skin and damaged portion of the core were removed and the skin edges were trimmed to a smooth transition. The Nomex honeycomb core in the damaged area was filled with an epoxy potting compound and cured for one hour at 180° F. A repair patch consisting of one layer of 120 style fiberglass impregnated with epoxy resin was cured for 4 hours at 135° F. After cure, the repaired area was sanded smooth and coated with a conductive metal filled epoxy coating which is acceptable for small areas in place of the standard flame sprayed aluminum.

(2) Relocation of Holes:

A total of six holes required relocation prior to installation of the panels. All the holes were in solid laminate areas and Figure 21 shows hole locations for the right hand wing-body fairing and the left hand wing-body fillet. The holes were filled with an epoxy resin filled with chopped glass fibers and cured for 4 hours at 135° F. The holes were drilled and countersunk using special tools and procedures detailed in Reference 1. All parts were solvent cleaned and repaired according to standard L-1011 finish specifications.

AFT ENGINE FAIRINGS

No visible damage was noted for the left hand fairing but a delamination of the outer ply on the inner skin of the right hand fairing was observed. The delamination was located along the upper edge near the forward end of the fairing. It is not known if the delamination was caused in service or upon removal of the fairing from aircraft N31007. All fastener holes on both fairings had to be filled and relocated to fit aircraft N31030.

(1) Repair Procedures:

Delamination of the right hand fairing was repaired by removing the delaminated ply and replacing with 120 style fiberglass impregnated with epoxy resin. The patch was cured for 3 hours at 180° F.

Holes in the solid laminate portion of the panels were filled with epoxy resin filled with chopped glass fibers. Holes in the core area were filled with an epoxy casting resin. Both resins are suitable for 350°F service.

A reinforcing strip of one ply of 120 style fiberglass cloth impregnated with an epoxy resin was placed on both skins over all holes as shown in Figure 22. The resins were cured as follows: 1/2 hour at room temperature, 3 hours at 180°F and 2 hours at 335°F.

After the holes were filled and the resin cured, a skin-to-core delamination was noted on the inside of the left hand panel. Also, debonding of the Tedlar moisture barrier was noted in small areas on the inside of both panels. Due to shop error, the hole reinforcing strips were left off in some areas of both panels.

The delaminated area on the left hand panel was repaired with a patch of 120 style fiberglass impregnated with epoxy resin. The remainder of the hole reinforcing strips were applied. The panels were then vacuum bagged and cured under vacuum as follows: Heat to 190°F, hold 2 hours; Heat to 300°F, hold 1 hour; and heat to 335°F, hold 2 hours. A heat-up rate of 5°F/minute was followed. A 10 mil vapor barrier coating was used to replace the Tedlar as shown in Figure 23.

A shop error was found when the panels were being readied for final painting. The flame sprayed aluminum had mistakenly been sanded off the outer surface of the left hand panel. The flame sprayed aluminum was reapplied by Plasma Technology, Gardena, California. Their process is acceptable for repair, but it produces a more porous appearance than the flame sprayed aluminum applied in the production tooling according to standard Lockheed Procedures. Figure 24 shows the porous appearance of the flame sprayed aluminum.

The relocated holes were drilled and countersunk in the same manner as described for the wing-body fairings. Slight trimming of the top edge of the panel was required. This was accomplished using the porto-shear discussed in Reference 1. Small areas around holes where flame sprayed aluminum was missing were repaired with conductive, aluminum filled epoxy. The panels were repainted per standard Lockheed procedures.

MANHOURS REQUIRED FOR REWORKING THE TWA FAIRINGS

The total factory man-hours required for rework and installation of the Kevlar-49 fairings was 188 hours. This includes a standard 10% add-on for Quality Assurance, but does not include Engineering hours required to maintain liaison with this activity. The flame spray application, performed by an outside supplier, is the only rework operation not included in these man-hours. This was a relatively minor cost, however.

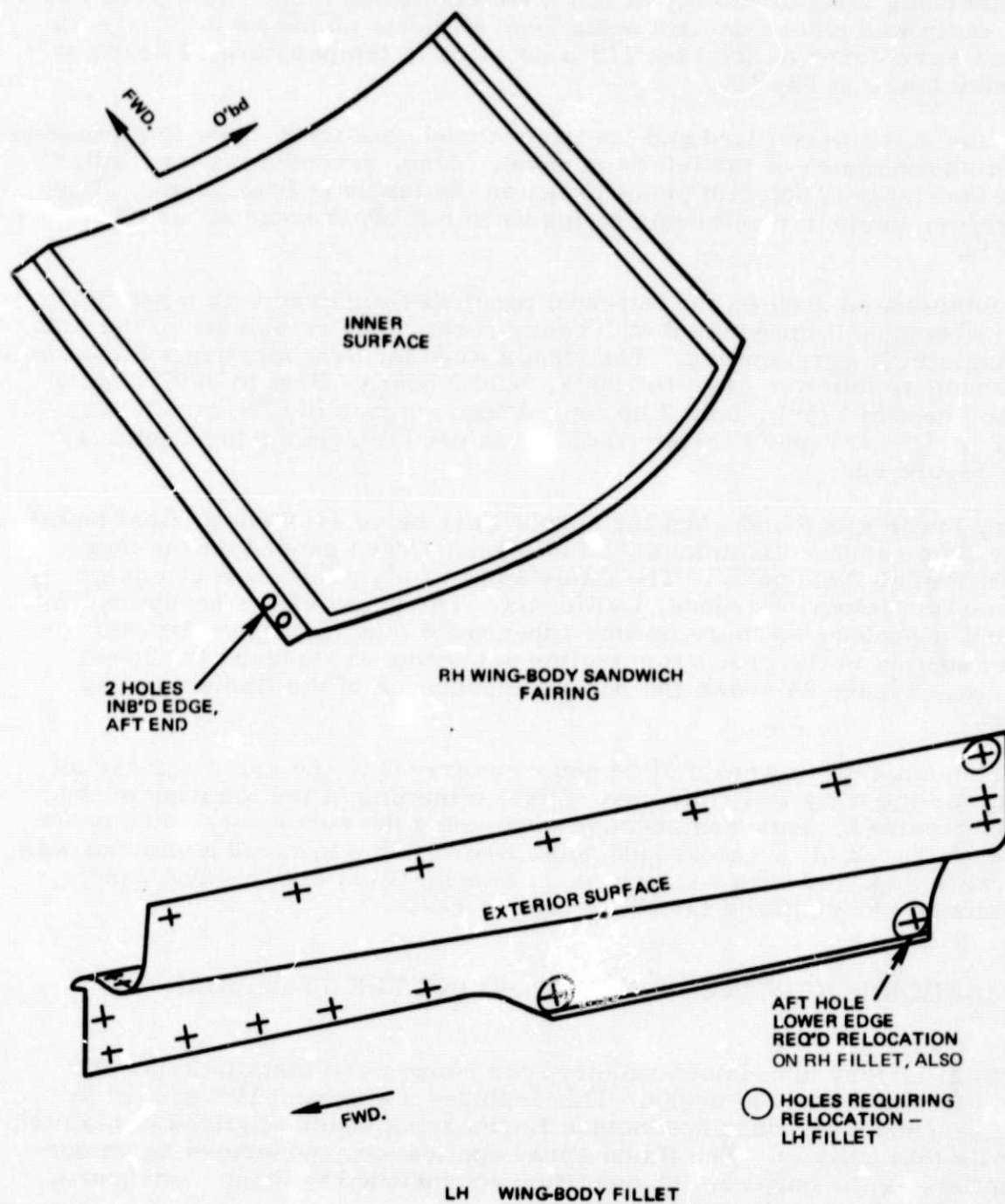


Figure 21. - TWA Under-Wing Panels
Location of holes requiring filling

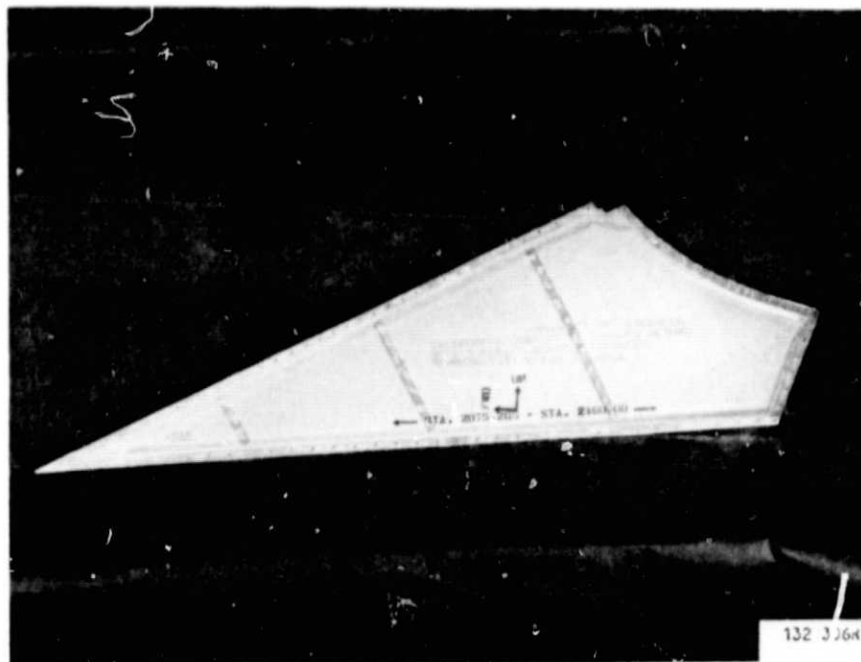


Figure 22. - TWA Aft Engine Fairing -
Inner surface showing fastener
reinforcing strips (before finishing)

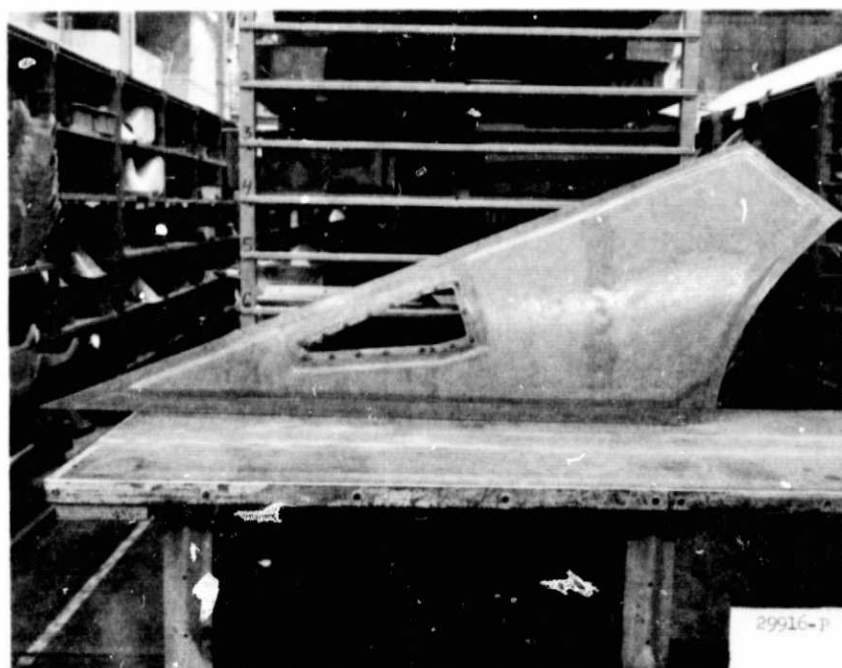


Figure 23. - TWA L/H Aft Engine Fairing -
Vapor barrier coating

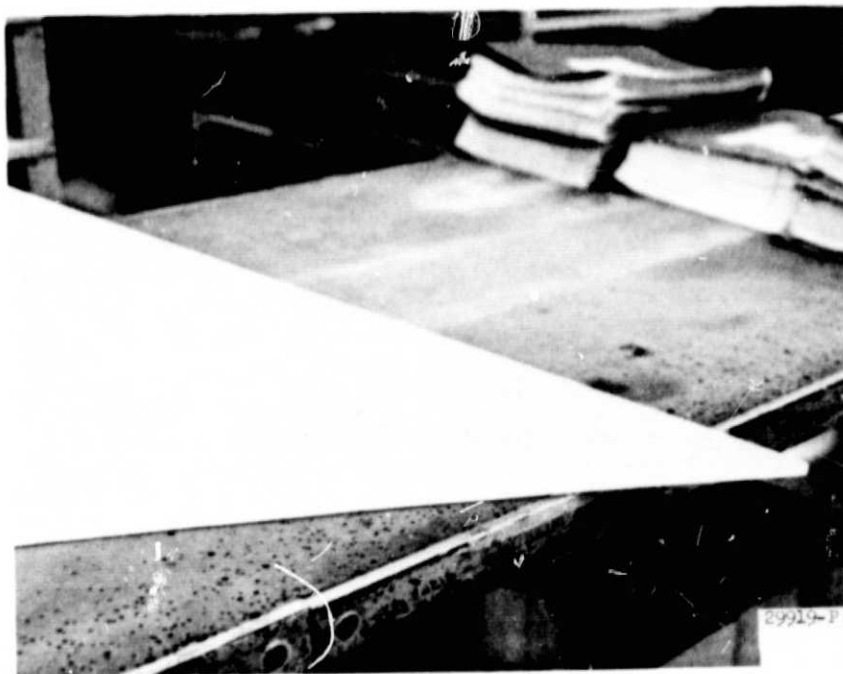


Figure 24. - TWA Aft Engine Fairing
After re-application of Flame Spray